INSECTS AND DISEASES OF EVERGREENS IN NEW MEXICO

New Mexico Dept. of Agriculture
Forest Service — U.S. Dept. of Agriculture
New Mexico Dept. of State Forestry
Cooperative Extension Service
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INTRODUCTION

Cities grow, suburbs expand, and the demand for greenbelts, parks, ornamental and shade trees increases greatly each year. People have learned that trees and other green plants are a vital part of their life-support system. Green, healthy vegetation supplies oxygen, filters dust from city air, reduces noise pollution, lowers the temperature along urban streets by 10 or more degrees, serves as a windbreak, and increases the quality of life in many other ways. Planting native evergreen trees and shrubs can create a more natural landscape, save money, or reduce the costs of maintenance and water use.

Evergreens in New Mexico are not easily transplanted. Their root systems are extensive and spread out several feet from the tree. Generally, few of these roots remain intact when the tree is dug up; consequently, a high percentage of trees fail to survive transplanting. Survival rate can be more than doubled by root-pruning 12 months or more before digging. Root-pruning is accomplished by cutting the roots with a narrow-pointed shovel from 1 to 3 feet out from the tree to a depth of 12 to 18 inches. Root-pruning should be done in November, December, or January, and is most easily done immediately following a rain or snowmelt. Evergreens must be moved with a ball of soil held firmly intact around their roots. The ball of soil should be wrapped with burlap and tied tightly to prevent the soil from crumbling away from the roots during transporation and handling. It is not necessary to remove the burlap wrapping when resetting the plant in the ground because it will rot away within a few weeks.

Whenever a tree is transplanted, it must adjust to a new set of living conditions, some of which are subtle, while some are abrupt. Without man's help, most trees will have a rough time adjusting to the new conditions, many of which are too harsh for its normal development or too extreme for its survival. In urban areas throughout New Mexico, evergreen trees will need supplemental watering in the windy spring months and at other dry times of the year. At these times, normal rainfall will be inadequate to maintain tree health and vigorous growth. The failure of the tree to adjust brings about distress symptoms. Symptoms are produced from two general sources: the living agents (biotic), and the physical environment (abiotic). The biotic agents are insects, animal pests, plant pathogens, and plant parasites. Abiotic agents are soil, climate, weather conditions, and man-modified atmospheric and soil conditions. All of these factors must be taken into account to diagnose tree problems. In this publication we will deal exclusively with insects and diseases.

This publication has been prepared to help homeowners and forest landowners identify insect and disease pests of New Mexico evergreen trees. The insects and diseases included are the most common ones attacking ornamental and forest trees. Prompt identification and treatment of these pests are essential to minimize the loss of valuable shade and forest trees. This is particularly important in the Southwest where the extreme dry and windy seasonal conditions place extra stress on the trees and make them highly susceptible to attack. The prevention of attack is greatly enhanced by keeping the trees in a healthy, vigorous, growing condition.

The following pages include descriptions of pests, pictures of damage, and pictures of the damage-causing organism where possible. Recommended chemical control methods are not included because changes frequently take place in chemical registration and chemical-use regulations. Pest control is a growing field and changes in its technology develop rapidly. New pesticides are being made available constantly which quickly replace older materials. For recommended chemical controls, contact your county Agriculture Extension Agent or the Cooperative Extension Service at New Mexico State University. Other advice may be obtained by contacting the New Mexico Department of Agriculture; New Mexico Department of State Forestry; or U.S. Forest Service, Region 3, Forest Insect and Disease Management, Albuquerque, New Mexico.

For their assistance in the preparation of this publication, we wish to credit personnel of the New Mexico Department of Agriculture, New Mexico Department of State Forestry, U.S. Forest Service, and Cooperative Extension Service. We hope that you will find this publication useful in maintaining your evergreen trees.

State law prohibits the removal of any plant within 300 feet of a public thoroughfare. The law also requires that a written permit be obtained from the landowner or land manager for any plants removed. Additionally, persons digging and selling plants on a commercial basis must apply for a Collected Plant Inspection Certificate and/or a Dealers License from the New Mexico Department of Agriculture. You are advised to observe these laws and regulations.

TREE SPECIES, BY POINT OF ATTACK

Insect species	Pinyon	Ponderosa	Other pines	White fir	Douglas-fir	Blue spruce	Engelmann spruce	Juniper (cedars)
Pitch nodule moth	ST, BR, LI	ST, BR, LI	ST, BR, LI					
Pine tip moth	BU, ST	BU, ST	BU, ST					
Bark moth and pitch moth	BR, LI, TR	BR, LI, TR	BR, LI, TR	LI, TR	LI, TR			
Ips bark beetles	UB	UB	UB		UB			
Dendroctonus bark beetles		UB	UB	UB	UB	UB	UB	
Pine needle scale	NE	NE	NE		NE			
Pinyon needle scale	NE							
Conifer aphids	LI, TW, BR	LI, TW, BR	LI, TW, BR	LI, TW, BR	LI, TW, BR	LI, TW, BR	LI, TW, BR	LI, TW, BR
Cooley spruce gall aphid					NE, TW	BU	BU	
Douglas-fir tussock moth				NE	NE	NE	NE	
Tiger moth	NE	NE	NE					
Mistletoes	BR, LI, TR	BR, LI, TR	BR, LI, TR	BR, LI	BR, LI	BR, LI	BR, LI	BR, LI, TR
Broom rusts			BR, LI	BR, LI	BR, LI	BR, LI		
Non-infectious diseases	WH	WH	WH	WH	WH	WH	WH	WH

BU = Buds; NE = Needles; TW = Twigs; ST = Shoots and Tips; BR = Branches; LI = Limbs; TR = Trunk; UB = Under bark; WH = Whole tree.

PITCH NODULE MOTH

Petrova sp.

The pitch nodule moth attacks primarily pinyon, but may also attack other pines in New Mexico. The most conspicuous evidence of attack by this insect is fading branch tips associated with the characteristic "pitch nodule." The pitch nodules are hollow balls of pitch, about ½ inch in diameter, formed at the points of attack on branch tips. The tips soon die and turn light brown. Dead needles may persist for several months, but eventually fall off. The barren twigs, with the drying pitch nodules, remain for a year or more, after which they fall off, leaving the tree deformed and unsightly.

The larvae do not attack buds, but usually bore into new twigs just below the tips and kill the tips by tunneling down the twigs. Old growth branches and stems are occasionally attacked, but not often in New Mexico. The larvae usually bore into the bark at nodes or whorls of branches and the point of attack is always characterized by a pitch nodule. Mature larvae are dirty-white to brown and about ½ inch long. Pupation takes place inside the pitch nodule from early to mid-summer. The pupae move to the surface just before adult emergence and the moths escape through small holes in the pitch nodules.

There are no registered insecticides to control this insect. In the forest environment, tip-killing is rarely important. On ornamentals of high value, the insect may be controlled by pruning the infested tips as they fade and disposing of them in May or June before the adult moths emerge. On branches and stems, the larvae may be destroyed by crushing them within the pitch nodule.

Characteristic reddish-brown "pitch nodule" on green twig indicates new attack.

Dead tips and old "pitch nodule" with adult exit hole.

PINE TIP MOTHS

Rhyacionia spp.

These insects primarily attack very young ponderosa from 6 inches to 6 feet. Although mortality is rare, heavily infested trees may be severely stunted or deformed. Generally, ponderosa pines grow out of the susceptible stage within a few years, but the branch tips of pinyon are susceptible to attack for many years. Repeated attacks over several years can weaken trees and predispose them to attack by other insects. The adult insect develops in May and June, and damage is evident in early summer. Tips, twigs, laterals, and terminals turn a straw color, and needles fall off in late fall.

Eggs are laid on new shoots or needles near terminal buds in May or early June. The newly-hatched larvae bore into buds, laterals, and terminals, and mine out the pith from the tip down to the base of the shoot. The point of attack is marked by a small flow of resin, but no "pitch nodule" is formed. The larvae are yellow to orange to brown and are ½ to ¾ inches long when full grown. Tip moths over-winter as pupae in the tips or shoots of infested trees, in bark crevices, or in the litter below the tree. There is one generation each year in New Mexico.

In the forest environment, chemical control measures are rarely necessary except in young plantations. Heavily attacked ornamentals may require an insecticide for control. For a few small trees, the best home method to control this damaging insect is to prune infested tips and shoots in May or June when the needles begin to yellow and destroy them by burning or burying.

Ponderosa pine terminal and pinyon tips killed by tip moth larvae. These tips and shoots can be pruned for successful control.

IPS ENGRAVER BEETLES

Ips spp.

Ips beetles attack both ponderosa and pinyon pines. Usually they attack trees weakened by drought, lightning strikes, root disturbances, soil compaction, and changes in soil depth around the tree. These insects will also attack fresh slash left on the ground from such activities as road and home construction, logging operations, and land-clearing projects.

Trees that are attacked are rapidly girdled by the adults as they construct their egg galleries in the inner bark. Girdling is also done by the young larvae as they feed outward from the egg gallery. Adult beetles introduce a blue stain fungus into the tree during attack and tunnel construction. Growth of the fungus blocks the flow of water and nutrients in the tree. This blockage, combined with the girdling by the adult and young beetles, causes death of the tree.

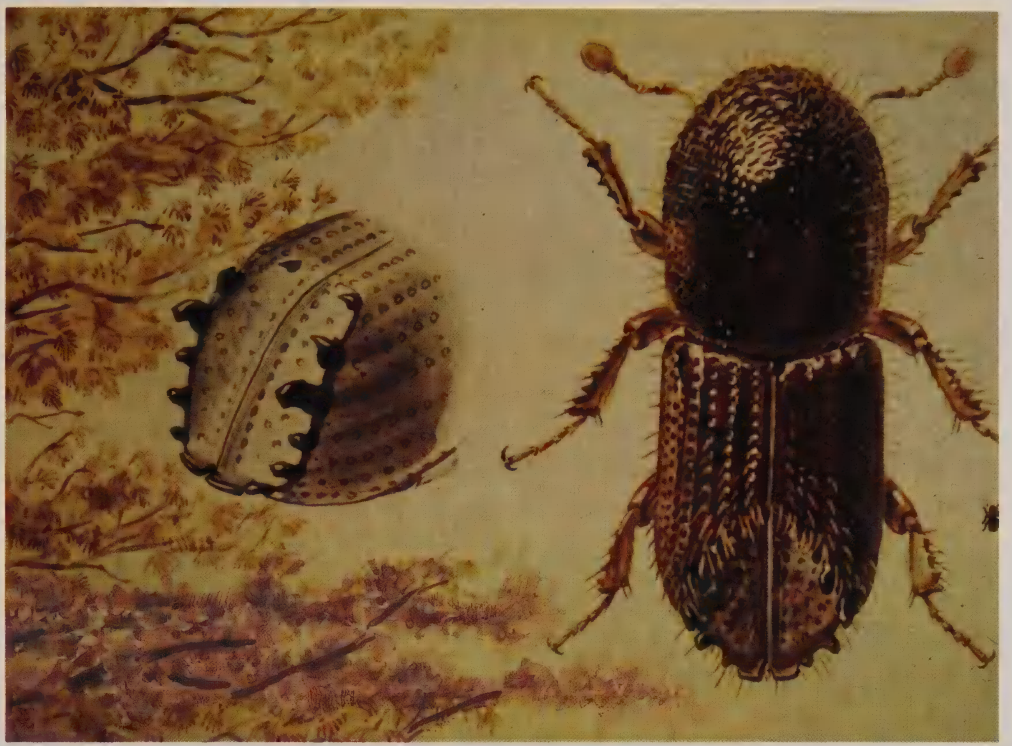
Small reddish-white pitch masses and reddish boring dust are the first signs of beetle attack. Removal of the bark from an infested tree will reveal typical "Y" tuning fork or H-shaped tunnels with short larval feeding galleries extending perpendicularly from either side of the egg galleries. The Y- or H-shaped galleries are always clear of boring dust and other debris. Fading of the needles in the top third of the crown is also an early sign of *Ips* beetle attack. In ponderosa pine, the needles first turn to a light straw color and then to a dark reddish brown. In pinyon, the needles on the entire tree turn to a deep reddish brown.

Typical clean "tuning fork" gallery of *Ipps*.

Ips beetles are easily recognized by their "scooped out" posterior which is surrounded by varying numbers of spine-like projections. It takes only 3 to 5 weeks to complete their life cycle from egg to adult beetles. The short life cycle allows beetle populations to increase rapidly from spring through fall seasons.

The best method of control is the immediate removal and use of infested trees. Clear plastic sheeting may be used to cover infested firewood and slash piles. The sun creates high, lethal temperatures under the covering and kills the beetles and larvae in the infested material in 2 or 3 weeks.

When digging native evergreens in the wild near land-clearing projects or in other areas of ground or tree disturbance, extreme care must be used in examining and selecting trees for digging and removal to be sure that they are not infested with *Ips* beetles.



Adult *Ipps* bark beetle. Note the indented rear end and spines at the edge of indentation.

Fading ponderosa pine, characteristic of *Ipps* bark beetle attacks at top of main stem.

BARK BEETLES

Dendroctonus spp.

This group of bark beetles attacks medium to large ponderosa pine, blue spruce, Engelmann spruce, and Douglas-fir trees in New Mexico. In contrast to the *Ips* engraver, these insects are usually not a problem in new ornamental plantings, but occasionally cause extensive damage and tree mortality in natural forested areas and in heavily forested urban communities. Drought, lightning strikes, overstocked stands, and other factors that cause low tree vigor contribute to buildup and help maintain damaging beetle populations. Man-made disturbances in natural stands, such as tract development, road construction, and logging, where trees and slash are supplied on a continuing basis, contribute to rapid increases in beetle populations. Also, windthrow is an especially serious problem in spruce stands.

Adult beetles in this group are about the size of the head of a wooden match. They bore directly through the bark, mate, and the female excavates egg galleries. Removal of the bark from an infested tree will reveal straight, slightly curved, or S-shaped galleries. The galleries are filled with boring dust, frass, and other debris, while *Ips* galleries are clean and clear.

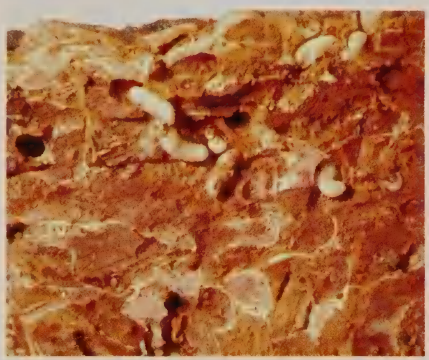
First outward signs of beetle attack are pitch tubes and boring dust. Pitch tubes are a mixture of pitch or resin and boring dust exuded through the attack hole. The tubes may be clear to cream colored or dark red. Fading of all needles throughout the crown is a sign of beetle attack by species of this group. Needle-fade may occur from 2 months to a year after successful attack in ponderosa pine. The usual color change is from yellow-green to straw to brown. Dead needles usually drop soon after browning, depending on weather conditions. In Douglas-fir, needle-color change is from yellow to reddish brown. Fading of spruce needles usually begins 10 to 15 months after attack. Needle-color change is to light yellow-green, to light brown, to reddish-orange. Dead needles may remain on spruce for a year after color change begins or about 2 years after successful attack.

Bark beetles of this group have a rounded posterior and spines are not present. Most species in this group, except the spruce beetle, take 1 year to complete their life cycle from egg to adult beetle. The spruce beetle takes 2 years, but has a flight and brood produced each year. The beetles of this group carry the blue stain fungus and introduce the fungus into the trees upon attack. Growth of the fungus blocks the flow of water and nutrients. The blockage, combined with the girdling by the adult and young beetles, causes death of the tree.

Groups of ponderosa pine killed by *Dendroctonus* bark beetles. Beetle attack in lower trunk causes entire tree to fade and die.

Control includes rapid utilization of infested trees, continuous slash cleanup, and piling and burning of infested slash. There are no recommended chemical control methods. Homeowners should remove any infested trees at once to prevent emerging adults from attacking adjacent trees. Infested trees are hazard trees and the emerging adult beetles will attack trees nearby and possibly kill a group of trees or a whole stand of trees.

Adult *Dendroctonus* bark beetle. Note rounded rear end.



Larvae and pupae, two of the four life-stages of *Dendroctonus* bark beetles, in bark.

Typical debris-filled gallery of *Dendroctonus* bark beetles. Eggs are laid by the female adult at edge of gallery.

Clear plastic-covered piles of beetle-infested wood. The sun generates temperatures lethal to the beetles infesting the wood.

Small flows of pitch on the tree trunk indicate attack by these bark beetles.

BARK MOTHS AND PITCH MOTHS

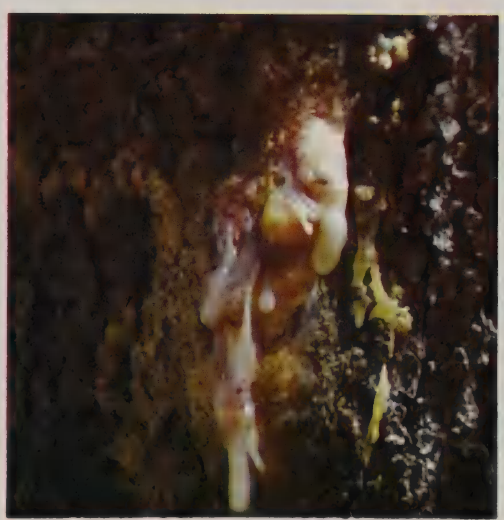
Dioryctria spp. and *Vespamima* spp.

These two insects are listed together because their habits and effects on trees are very similar. The moths attack the larger branches, limbs, and trunks of young ponderosa and pinyon. Occasionally, Douglas-fir and the true firs are also attacked. The most severe damage is to trees under 20 feet, especially in urban areas. The insects are rarely a problem on larger trees or in the forest environment. The main difference between the two insects is in the length of their life cycle. The pitch moths (*Vespamima* spp.) require 2 years for one generation and overwinter as larvae each winter, while the bark moths (*Dioryctria* spp.) require only 1 year for a generation and overwinter as eggs or larvae.

Eggs are laid in bark crevices or near mechanical wounds on the bark. The newly-hatched larvae tunnel under the bark, forming irregular tunnels and tunneled-out areas, or they simply extend the bark wounds near where the eggs are laid. Larvae feed on pitch which flows from the tree in response to their tunneling. Great masses of pitch, 1 to 3 inches in diameter, form around the entry holes and conceal the larvae and their destructive tunneling from view. Generally, there is only one larva under each pitch mass. Full grown larvae are from ¾ to 1 inch long and are dirty white, yellow, reddish yellow, light green, or light brown.

There are no insecticides registered for use on these insects. The only effective control is the simple removal of the larvae from the pitch masses with a knife or similar tool.

Typical pitch masses on pinyon trunks and branches formed in response to larval tunneling.



PINE NEEDLE SCALE

Phenacaspis pinifoliae

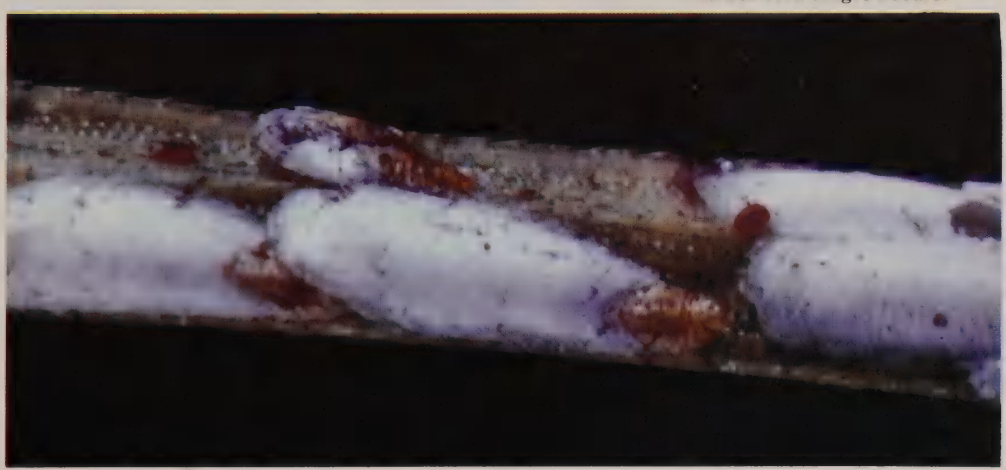
The pine needle scale is a common pest of most species of pines and occasionally of spruce and Douglas-fir. The scale insects feed on evergreens by piercing the needles with their mouthparts and sucking the sap from the needles. Early signs of feeding injury are spotting and yellowing of the needles. Infested branches suffer needle loss and slowly wither as the scales continue to feed for 2 or 3 years. Heavy infestations cause the trees to appear yellowish or grayish and unhealthy. Continued feeding gradually kills the branches and the tree may die if it remains untreated.

Generally, there are two generations each year and both dead and living scales can be seen on the needles all year. The mature female scale is white, slender, flattened, and about ⅛ inch long. Mature males are about half as large as females. Eggs are laid in the fall and remain under the dead female scale-covering during the winter. The eggs hatch when new needles appear in the spring, and tiny nymphs crawl to green needles and begin feeding. By mid-July, the scales mature and new clusters of eggs are laid. Scales of this new generation mature by early fall and lay the eggs which overwinter.

Damage is most troublesome on ornamental trees and is often noticed along dusty roads where people are likely to dig small trees to transplant in the home yard. Anyone who plans to dig or buy evergreens to transplant should inspect the needles carefully for the presence of scales or signs of their feeding. Cutting and burning infested trees is the only effective cultural control alternative to chemical pesticides. Lady beetles and certain wasps are the important natural controls of this insect.

Ponderosa pine needles infested with scales. Note the yellowing and spotting injury.

Enlarged view of female scales on a single needle.



CONIFER APHIDS

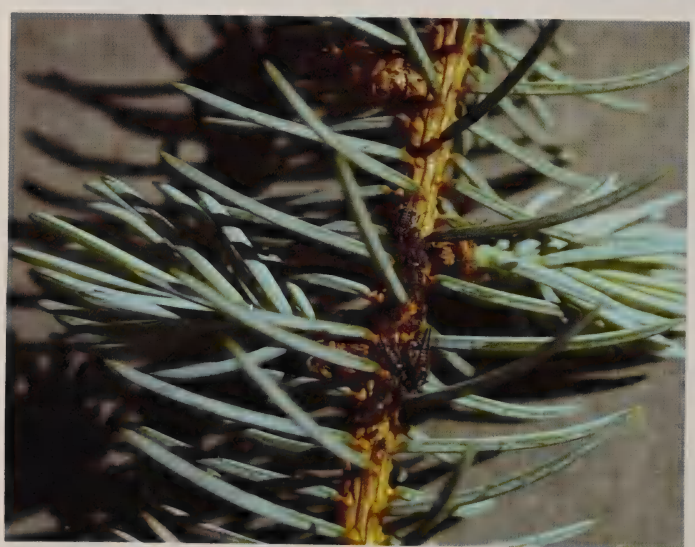
Cinara spp.

There are more than 35 species of conifer aphids found in the western States. Many of these species occur in New Mexico and attack the pines, true firs, Douglas-fir, and spruces. Conifer aphids are rarely a problem in the forest, but are often annoying pests on ornamentals and shade trees around homes. Frequently, trees are so weakened that they die in a few seasons or become subject to attack by other insects.

Most of the conifer aphids are quite large, up to ¼ inch, and are generally dark colored. They are long-legged and have naked bodies or are lightly covered with a powdery wax. There are a number of generations produced each year with both winged and wingless forms.

Damage is caused primarily by aphids feeding on the branches and twigs. They pierce the bark of the branch and suck out great quantities of sap. Needle growth is reduced, twigs dry, and heavy defoliation occurs with excessive feeding. Since the aphids cannot utilize all of the liquid portion of the sap, they expell the excess from their bodies. The expelled liquid is called "honeydew" and contains sugars and other compounds which are sweet and very sticky. The honeydew rains down on lower branches, the ground, and other objects directly below the feeding aphids and turns the objects into a sticky mess. A black "sooty-mold fungus" often grows on the honeydew and thus the objects become covered with a black slime. Sometimes it appears as though the tree and adjacent area were sprayed with crude oil.

There are several chemical pesticides which are effective in the control of conifer aphids. The timing of spray application or other chemical control measure is not critical to the success of control efforts.



Wingless aphids feeding on spruce branch.

Winged aphids feeding and reproducing on spruce branch.

COOLEY SPRUCE GALL APHID

Adelges cooleyi

There are several kinds of spruce gall aphids which form cone-shaped galls on the terminal twigs of various species of spruce. The most common one in New Mexico is the Cooley spruce gall aphid which is not usually considered an important pest in the forest. However, it is often troublesome on ornamental spruce and in Christmas tree plantations where the young trees may be aesthetically damaged by large numbers of unsightly galls. The life history of this insect is quite complex and involves two different host trees and at least five different winged and wingless forms.

Generally, winged females migrate from Douglas-fir to spruce where they lay eggs at the bases of newly forming buds in early spring. Nymphs hatch from these eggs and begin to feed at the bases of the very young needles. The nymphs soon become enclosed in the rapidly developing galls. The galls are an abnormal growth response to the feeding by the nymphs. Young galls vary from green to purple, while older galls are purplish or reddish brown. By mid-July, the galls are from 1 to 3 inches long and contain from 50 to 350 maturing nymphs. At this time, the galls begin to dry and open, allowing the mature nymphs to crawl out to the needles. The nymphs transform to winged adults and fly back to Douglas-fir. The adults on Douglas-fir lay eggs which hatch and produce a generation of "woolly aphids." The insects look like little fluffy balls of cotton clinging to the needles. Occasionally, Douglas-fir will be so heavily attacked that it looks as though snow had fallen on the tree. Feeding by the insect produces yellow spots on the needles and occasionally produces bent and distorted needles. Eventually another winged form is produced on Douglas-fir and it migrates to spruce again completing the life cycle.

There are insecticides to suppress the aphid; however, the timing of spray application is difficult to determine for effective control. On small ornamentals, the galls may be pruned off and disposed of before the release of the nymphs which become winged and migrate to Douglas-fir. It may also help to plant spruce or Douglas-fir exclusively, instead of planting both tree species together.

Mature gall on spruce twig. Note openings from which winged adults emerge.

Alternate life-stage or "woolly aphid" on Douglas-fir.

PINYON NEEDLE SCALE

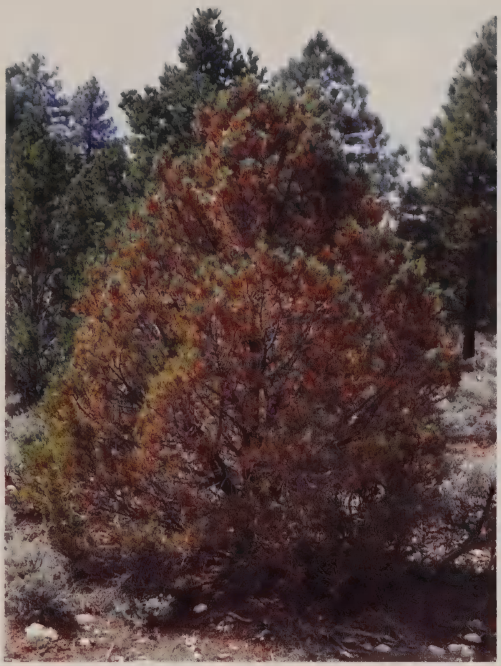
Matsucoccus acalyptus

The pinyon needle scale is a tiny sap-sucking insect which can cause extensive injury to pinyon pines in the forest condition or when used as ornamentals. The scales infest 1-year-old needles and greatly weaken the trees by their feeding. Feeding causes reduced needle growth or needle loss. Heavy infestations often leave the branches with only a few stunted needles clustered at the tips. Small trees frequently die, while weakened larger trees become susceptible to attack by other insects, especially bark beetles, which can kill trees.

Early signs of attack are easily seen with the naked eye. During mid to late April, newly-emerged females lay clusters of yellow eggs held together in loose, white, cottony webbing. The egg masses and webbing are found on the undersides of large limbs, in crotches of large branches, in rough bark cracks, and around the root collar at the base of the tree. From these eggs develops a tiny crawler stage. The crawlers move to the ends of branches and settle on the needles in early June. In a day or so, the settled scales cover themselves with a waxy substance and turn black. At this point, they are about 1/16 inch in length, bean-shaped, and motionless. They feed through most of the growing season.

Insecticides are available to control this insect on ornamental trees, but timing the spray application is critical for effective control. An inexpensive and effective cultural control alternative has been developed. The procedure is to wash down the tree with a garden hose to dislodge the eggs and webbing. Next, the dislodged eggs, webbing, litter, and debris on the ground under the tree are raked up and bagged. Finally, the bagged materials are disposed of by burning or burying. This method of control should be accomplished before eggs hatch. In New Mexico, depending on weather, the time to wash down trees will be between the first of April and mid-May.

Scales infesting one-year-old needles.



Heavily infested and damaged pinyon. Only the new growth remains green.

Cottony webbing and eggs laid on rough trunk bark.

Cottony webbing and eggs laid at base of tree trunk.

DOUGLAS-FIR TUSSOCK MOTH

Orgyia pseudotsugata

The Douglas-fir tussock moth is one of the most destructive forest insects on ornamentals in the Southwest. In New Mexico, it has been a persistent pest of spruce, white fir, and Douglas-fir planted as ornamentals or shade trees.

Larvae hatch in the spring and feed on the new foliage, causing it to turn brown and shrivel. As they continue to grow, they feed on both new and older foliage lower in the crown and farther back on the branches. Heavy feeding causes severe defoliation and the tree begins to turn a reddish brown starting at the top and advancing down to progressively lower limbs during the year or in successive years. Repeated defoliation may cause top-kill or tree mortality. Fully grown larvae are grayish to light brown and are from 1 to 1¼ inches long. The body is covered with a variety of short to long hairs arranged in a distinctive pattern. The most conspicuous hairs occur in two forms: four dense, buff-colored tussocks or clumps of hairs are located forward along the middle of the back; and three long, brush-like tufts form hornlike structures, two of which are located just behind the head, with the third brush on the tail end. Except for the head and legs, the rest of the body is covered with short hairs growing out from reddish button-like spots. Many people are sensitive or allergic to the hairs which can irritate the skin and may produce an itchy rash or blisters.

The tussock moth produces one generation each year. Adult moths emerge from late July to early September. Their cocoons are attached to the underside of limbs, branches, and foliated twigs. After mating, the wingless female clings to her cocoon and lays white eggs in a mass about the size of a dime on its surface. While laying the eggs, she glues her body hairs to the egg mass and they overwinter in a brownish woolly mass.

The removal and destruction of the egg masses, cocoons, and larvae will control this insect on very small home-planted ornamentals. Larger infested trees will require the use of an insecticide for control. A microbial insecticide, *Bacillus thuringiensis,* is a bacterium that produces a toxin, lethal to many kinds of moth larvae. *B. thuringiensis* has been tested in New Mexico on the Douglas-fir tussock moth and was found to give satisfactory control. Because this insecticide is specific to insects, it is safe to use, is biodegradable, and is a logical alternative to chemical insecticides in use.

Mature larva feeding on new needles. Note tussocks on back.

Wingless female laying eggs in a mass on twig.

Severe defoliation causes browning and top kill.

A TIGER MOTH

Halisidota ingens

The natural parasites of this moth prevent it from becoming a serious forest pest, although it may be damaging to young ponderosa or pinyon pines in commercial plantations. The webbing and defoliation of branches by the larvae are very unsightly on ornamentals.

The tiger moth produces one generation each year. Adult moths emerge from mid-July to late August, and light green eggs are laid in clusters on twigs and needles of the host trees. The eggs hatch in 3 to 6 weeks, producing small, gregarious larvae which are dark brown to black and quite hairy. Groups of young larvae feed on the current needles and form webs or tents enclosing a portion of the branch. Feeding continues through the fall and the larvae overwinter within the tents. The tents are usually located in the topmost branches or on the south and west sides of the trees. When temperatures are warm, the larvae may continue to feed outside the webbing and return to the tent before nightfall. By early spring, the tents are large, conspicuous, and filled with masses of dead needles.

The caterpillars no longer feed in groups as they approach their full growth, but feed alone away from the tent, often migrating to another tree. Full-grown caterpillars are about 1½ inches in length and are covered with light yellow-brown to dark brown poisonous hairs which can produce rashes and blisters on the skin of people who are sensitive to them. Pupation occurs in June and the mature caterpillars spin brownish cocoons made of silk and body hairs. Cocoons are attached to branches, limbs, and trunks of the host trees, and occasionally to debris on the ground.

Insecticides are available for control, but are not generally necessary. An inexpensive cultural control method consists of pruning the branches with tents and burning them while the small larvae are inside.

Some webbing and nearly full-grown caterpillars.

Typical tent as it appears in early spring along with defoliated tips.

MISTLETOES

Arceuthobium spp. and *Phoradendron* spp.

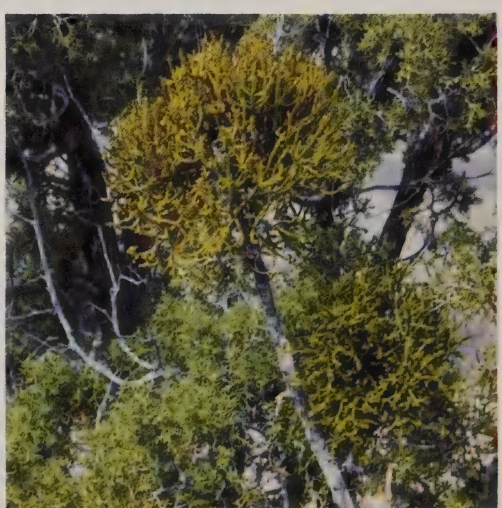
The mistletoes are parasitic plants that cause injury to their woody hosts. The two types of mistletoe found in New Mexico are dwarf mistletoes and true mistletoes. Dwarf mistletoes live on conifers only, while true mistletoes occur on conifer and hardwood trees and shrubs. The parasitic mistletoes withdraw essential nutrients and water from their host, resulting in injury and sometimes tree mortality.

In New Mexico, dwarf mistletoes attack ponderosa pine, southwestern white pine, pinyon, Douglas-fir, Engelmann spruce, and blue spruce, while true mistletoes are found on several species of juniper, numerous species of oak, and other hardwoods. The mistletoe plant varies in color from green to red-green. Dwarf mistletoe plants vary in size from an inconspicuous bud-like structure protruding through the tree bark to shoots nearly a foot long. True mistletoe plants vary in size from several inches to several feet in length. Symptoms of mistletoe infection include swelling at infection sites and the formation of witches' brooms.

Ponderosa pine branches heavily infected with dwarf mistletoe. Note branch swelling and disfiguration.

Dwarf mistletoes are spread by explosive fruits which shoot seeds 20 to 30 feet into the surrounding area. True mistletoes are spread by birds that feed on the mistletoe berries. The seeds from the berries pass through the bird unharmed and are thus spread in the bird feces.

Branches on mistletoe-infected trees may be pruned to reduce damage to the trees and to reduce further spread of the parasite. No chemical or biological controls are available for mistletoe control.



True mistletoe infecting juniper, a common sight in New Mexico.

BROOM RUSTS

Two of the most important broom rusts in New Mexico are spruce broom rust and fir broom rust. The host trees for spruce broom rust are Engelmann spruce and blue spruce, while the hosts for fir broom rust are alpine fir and white fir. Broom rust fungi require an alternate host to complete their life cycle, and the alternate host plants must be present in the area for successful spread of broom rust. Kinnikinnick is the alternate host for spruce broom rust, and chickweed is the alternate host for fir broom rust.

Trees infected by broom rust are easily recognized by the witches' brooms that form from infected branches. Witches' brooms are dense masses of branches that are conspicuous in infected trees. Generally, they are large and yellow. Needles of the brooms are often stunted and drop off in the fall each year. Other fungi and disease agents may cause the formation of witches' brooms, but only broom rusts cause yellowing of broom foliage and annual needle drop.

Broom rusts cause reduction in tree growth, top-kill, and some mortality. Rusts may create entry points for decay fungi. Witches' brooms may be pruned from trees with only a few branch infections if the infections are not too close to the tree trunk. Trunk infections are recognized by swelling of the trunk and cracks in the bark at infection sites.

There are no chemical or biological controls available for the control of broom rusts.

Large, dense witches broom in white fir.

Close-up of broom showing stunted, yellow needles.

NON-INFECTIOUS DISEASES

ENVIRONMENTAL AND MAN-CAUSED

Numerous non-infectious diseases cause injury to trees or death of trees. Two broad categories of non-infectious diseases are "environmental" and "man-caused." Any factor that causes a change in the tree's "normal" living and growing processes may cause injury. Injuries to trees can result from too much as well as too little of any basic requirement for tree growth.

ENVIRONMENTAL FACTORS

Cold Injury

Early or late frosts often cause damage to tree buds, foliage, or flowers. Sudden drops in temperature during the dormant season can cause cracking of the bark. Cold-injured trees often have reddened or rust-colored foliage and may suffer premature leaf drop.

Heat Injury

Tree tissues may be injured when they are exposed to temperatures above the maximum to which they are acclimated. Sunscald is one kind of heat injury which results from overheating and drying of the bark, and is characterized by reddening of the bark followed by canker formation. Premature leaf drop also occurs on heat-injured trees.

Water Injury

Shortage of available water may result in drying of foliage and twigs, with eventual mortality. Drought injury may cause foliage to turn yellow or brown and to be prematurely cast. Flooding of trees also causes injury by cutting off the oxygen available to the root system. Trees injured by excess water often have discolored leaves and spongy bark.

Nutrient Injury

A short supply of essential nutrients may cause injury or death of trees and an excess of nutrients may be toxic to the tree. Nutrient abnormalities are characterized by foliage discoloration and frequently by distortion of twigs and leaves.

Weather Injury

High winds often cause branch, limb, or trunk breakage and the uprooting of trees. Heavy snows cause limb breakage from excessive weight. Hail may cause wounding or death of buds, leaves, twigs, and branches. Lightning strikes on trees frequently cause breakage or formation of large cracks and burns in the bark.

Animal Injury

Birds or rodents feeding on or under tree bark can injure trees. Small trees and shrubs around the home are often injured by dog urine, and the injury is characterized by localized discoloration of the foliage. Trees are also wounded by cats "sharpening" their claws on the thin bark of small trees.

MAN-CAUSED FACTORS

Soil Compaction

Trampling of soil around trees by animals or compaction by machine traffic reduces soil aeration and percolation, resulting in yellowing of foliage, premature leaf drop, and death of the tree.

Mechanical Wounds

Wounding often results from use of machinery such as lawn mowers or from individual attacks on trees by children banging into them with bikes, wagons, or other toys. Excavation around trees may cause injury to the root systems.

Air Pollution

Toxic substances in the air surrounding trees may result in injury or death of certain trees and shrubs. Air pollution injury is characterized by discoloration of foliage and formation of spots or blotches on leaves. The most common air pollutants causing plant injury are sulfur dioxide, PAN, and ozone. Air pollution problems result most often from industrial emissions and vehicle exhaust.

Salt Injury

When roots take in water contaminated with sodium or chloride from highways treated with deicing salt, the result is often injury or tree mortality. Salt spray from passing vehicles also may cause injury to trees near treated highways. Salt-injured trees may have yellow, red, or brown needles. In the case of salt spray, injury occurs on one side of the tree only.

As indicated by the previous descriptions, many non-infectious diseases have similar symptoms. Thus, the diagnosis of disease problems is very often a difficult task even for trained personnel.

SAFETY RULES FOR USE OF PESTICIDES

1. Read entire label before using product.
2. Observe all precautions each time a material is used.
3. Store chemicals under lock and key out of reach of children and pets, away from food and feed.
4. Keep chemicals in their original containers.
5. Dispose of unused chemicals and empty containers in such a way that they are no longer hazardous.
6. Follow directions pertaining to residual tolerances on edible plants; allow the specified time interval between last application and harvest.
7. Use chemicals only on plants specified and at the correct rate and schedule.
8. Do not eat or smoke while applying pesticides.
9. Wear protective clothing and masks when directed on the label.
10. Bathe and change to clean clothing right after spraying or dusting. Wash clothing before reuse.
11. If chemicals are spilled on the skin or clothing, change clothing immediately and wash thoroughly.
12. If illness develops during or after a spraying or dusting operation, call a physician or take patient to hospital immediately.
13. Avoid chemical injury to plants; use separate equipment for herbicides.
14. Rates of application have been carefully computed; do not use more than recommended.
15. Do not spray or dust on a windy day; avoid drift that would injure plants on adjacent property.

Use Pesticides Safely

FOLLOW THE LABEL

U.S. DEPARTMENT OF AGRICULTURE

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